PRODUCTIVE USES OF RENEWABLE ENERGY:

Promoting Community Managed Micro Hydro Systems for Sustainable Development and Poverty Reduction

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1. BACKGROUND

Nepal is a small mountainous and landlocked country. Poverty is the key phenomenon which is severer in rural areas where 86% population reside. Inaccessibility, fragility, marginality and diversity are the mountain specificities which pose challenges for any development. Despite the planned development efforts of more than 50 years, today only about 40% of the total population of 23,214,681 (2001 Census) have access to the electricity from the national grid. The condition is still worse in rural Nepal where about 80% of the people do not have access to the electricity thereby leaving them to depend upon fuelwood, animal wastes and agricultural wastes to meet their ever increasing energy needs. As the consequences, the pressure on the natural resources has intensified worsening environmental degradation and hindering significant social and economic transformation. Experiences have proven that the prevailing practices of centralized development approach are not suitable for accessing electricity to the rural locations which are marked by the difficult terrain, scattered settlements and poor economic conditions. In this context, different development initiatives have proven that the promotion of rural energy technologies, primarily micro hydro system in a holistic manner encompassing social, economic and environmental aspects is the best feasible option for the rural electrification in settlements which are not likely to be connected by the national grid in the foreseeable future. Presently, many national and international agencies, donor organizations and non-government organizations have shown interests and supported for the implementation of progarmmes and projects for the wide scale promotion and dissemination of rural energy technologies in the country. Among others, the Rural Energy Development Programme (REDP) is a "best practice" programme that is recognized and rewarded both at the national and international arenas for its sustainable modality of harmonizing technology, social capital and natural resources for rural development and livelihoods strengthening .

2. RURAL ENERGY DEVELOPMENT PROGRAMME

Started on 16 August 1996 as a pilot initiative of HMGN and UNDP in five districts, the REDP got expanded to 10 districts in 1998, 15 districts in 2000 and 25 districts in 2003. Currently, the REDP is operational under the Alternative Energy Promotion Center (AEPC) as a joint project of HMGN, UNDP and the World Bank and supports for the expansion of the "best practice" programme activities to 150 to 200 VDCs for bringing benefits to tentatively 30,000 households (200,000 people) in the period of three years. The REDP provides assistance at all levels – for installation and operation of micro hydro systems at the community level, for planning and management at the district level and for policy and coordination at the central level. Important stakeholders include community people, NGOs, private sector, academic institutes, government line agencies and local bodies, namely District Development Committees (DDCs) and Village Development Committees (VDCs).

2.1 Operating Principles

From its inception, the REDP has practiced the holistic approach for sustainable development based on the community mobilization process with six basic principals commonly known as *Mul Mantras* in Nepali. They are (i) organization development,

(ii) skill enhancement, (iii) capital formation, (iv) technology promotion, (v) environment management, and (vi) vulnerable community empowerment. Participation, transparency, inclusion, consensus decision making and inclusion of all households in the community irrespective of class, color, creed and sex are four pillars of good governance that are internalized for ensuring equal ownership and equitable sharing of benefits accrued from the micro hydro systems.

2.2 Major Achievements

2.2.1 Organization Development

At community level

- Community Organization (CO): Formed 3,269 COs, of which 1,679 (51%) are female COs, as the broad base organizations to carryout various economic, social and environmental activities for holistic development.
- Micro Hydro Functional Group (MHFG): Formed 170 MHFGs and 170 Community Energy Funds (CEFs) for the planning implementation, fund mobilization operation and management and repair and maintenance of micro hydro systems. A MHFG is formed by all COs benefiting from a particular micro hydro system.
- Public Audit: Institutionalized the public audit of micro hydro system upon its completion. In addition, the accounts are audited by a registered auditor.

At district level

- Rural Energy Development Section (REDS): Established 25 RESCs under the DDCs in line with the Local Self Governance Act, 1999 as an autonomous and authoritative agency for policy, decentralized planning, management, coordination, monitoring and evaluation of the rural energy sector in the district. The REDS also acts as the Rural Energy Technology Promotion, Documentation and Dissemination Centre.
- District Energy Committee (DEC): Formed 25 DECs under DDC Chairpersons with the representatives of district level line agencies for supporting REDSs on policy matters, critical linkages and resources mobilization for energy sector development.
- District Energy Fund (DEF): Created 25 DEFs for the fund mobilization for the construction and operation of micro hydro systems.
- District Rural Energy Management Committee (DREMC): Created 25 DREMCs for facilitating the REDSs by taking operational decisions in line with the policy, approved workplan and budget.
- Support Organizations (SOs): Developed and strengthened 25 district-based NGOs as SOs through capacity building initiatives for implementation of community mobilization process and provision of support services to community people.
- Rural Energy Service Centres (RESCs): Developed and supported the private entrepreneurs to establish 13 RESCs for ensuring technical services to micro hydro and other rural energy technologies.

At centre level

- Programme Management Office (PMO): REDP is the PMO operating under the AEPC for implementation of the joint project of HMGN, UNDP and the World Bank.
- Programme Management Committee (PMC): Constituted with the representations from various government organization (AEPC, NPC, Ministry of Local Development and Ministry of Finance), District Energy Network (DENET), Association of DDCs (ADDCN), Association of VDCs (NAVIN), UNDP and REDP for policy guidance, decisions on implementation issues, coordination and monitoring and evaluation.
- Working Committee (WC): Constituted for day-to-day decisions making and actions, if needed, in support of the implementation of programme activities.
- District Energy Network (DENET): Created by DDC Chairpersons for networking, experience sharing, advocacy and lobbying on the rural energy.
- Committees, Forum and Networking: Formed different committees, forum and networking for linkages, information sharing, coordination and resource mobilization such as Micro Hydro Promoters Group (MHPG) with donors and INGOs, Consultative Forum (CF) with national level stakeholders and Networking with MH Manufacturers and Suppliers.

2.2.2 Skill Enhancement

The REDP has been giving priority to Human Resources Development initiatives for capacity building activities which have directly benefited approximately 20,000 rural people, of which about 8,500 are rural women. The activities include (a) Awareness Creation and Skill Enhancement through sensitization, orientation, workshop seminar, consultative meeting, observation study tours, etc., and (b) Training workshop seminars for developing micro hydro operators, managers, and repair and maintenance technicians, skilled persons to undertake improved agricultural practices, crafts production and forest based enterprises, and trained chairpersons and managers to lead and manage COs and FGs. Besides, staffs and stakeholders are oriented and trained on community mobilization, PRA, and decentralized planning and management, gender mainstreaming, rural energy technologies, monitoring and evaluation.

2.2.3 Capital Formation

A total of Rs. 23.48 millions have been saved by COs members as weekly saving, of which Rs 10.44 millions were saved by women COs. Similarly a cumulative total of Rs. 51.89 millions have been provided as loan to undertake various productive activities to CO members of which Rs. 24.23 millions were proved to members of the Women COs. In addition, approximately Rs.105 millions have already been mobilized by community people for the establishment of micro hydro systems from HMGN subsidy, loan from bank, equity form DDCs and VDCs and community contribution in the form of labor, local materials and cash.

2.2.4 Technology Promotion

The rural energy technologies promoted by the REDP include community managed micro hydro scheme, toiled attached biogas plant, solar pv home system and improved cooking stove. These systems are clean, renewable and locally appropriate. As of 31 December 2004, the programme has supported at community levels for producing impressive physical outputs that include (i) commissioning of 135 micro hydro systems with the total power output of 1716 kW benefiting more than 100,000 people, (ii) construction of 3,486 biogas plants with toilets, (iii) installation of 1,688 solar PV home systems and (iv) construction of 7,959 improved smokeless cooking stoves including 147 ICSs. Besides, the program has supported the community people to adopt various technologies related to irrigation, agriculture, livestock, forest management, micro enterprises and income generation.

2.2.5 Environment Management

Other equally important outputs are (i) establishment of 96 nurseries, (ii) development of 183 community managed forests, (iii) plantation of 2,714,873 trees including 87,261 fruit trees, (iv) construction of 12,111 toilets, (v) expansion or renovation of 1,321 ponds/taps, (vi) construction of 4,446 waste bins, (vii) expansion or renovation of 619 km of trail/rural roads, and (viii) organization of 322 environment classes/ campaigns.

2.2.6 Vulnerable Community Empowerment

The REDP prepares and implements Vulnerable Community Development Plan for each micro hydro system. The main purpose is to ensure the equity and equitable distribution of programme resources as well as the benefits from the programme activities. The programmes has ensured inclusion of 50 % of the women and 100% of all ethnic groups, marginalized communities and poor households from the programme areas. Community people provide special incentives to vulnerable communities in order to help ease them in the participation, contribution and utilization of systems and services for the benefits.

2.3 Major Outcomes and Key Impacts

Over 200,000 people have been benefited from the programme outcomes in terms of (i) access to electricity for more than 100,000 rural population, (ii) opportunities for productive employment and income generation, (iii) improved environment in and around homes and communities, (iv) reduced labor, time, drudgery and indoor smoke inhalation, (v) access to information, education and entertainment, (vi) capacity building at all levels, (vii) institutionalization for participatory planning, management, and monitoring, and (viii) coordination and linkages.

The visible impacts from the programme are noticed in (i) economic growth at household levels, (ii) enhanced natural resources management at local levels, (iii) strong social capital formation at community levels, (iv) improved health and hygiene at individual levels, (v) better education and increased literacy rate at household levels, (vi) empowerment at local levels, (vii) partnerships for synergetic results at district and national levels, and (viii) policy formulation at district and national levels.

2.3 Research and Development

In addition, the REDP has successfully carried out a number of research and development (R&D) initiatives with promising results through partnerships with individual experts, firms and academic institutes. They are (a) Bio-mass gasifier, (b) Pre-stressed RCC poles, (c) Low head propeller turbine, (d) Material transport ropeway in Dailekh district, (e) Plant seed oil, (f) Three phase induction generator controller, (g) Preservative treatment for MHS wooden poles, (h) Pump as turbine, (i) Turgo turbine, (j) Horizontal axis peltric set, (k) Computer aided design for MHS, (l) Low cost rural lighting (W-LED), (m) Motor starting system for MHP, (n) Hydro mechanical governor, (o) Grid connection of MHS, and (p) Pico hydro.

2.4 Recognitions and Rewards

The REDP has been evaluated and well appreciated in different studies and reports prepared by various national and international organizations and experts. The REDP experiences and lesson learned have been presented and documented in different national and international workshop seminars. The SURF UNDP has evaluated the REDP as the "best practice" programme. The REDP was featured in the EXPO 2000 Germany and awarded Second Prize in the Energy Globe Award 2000 Austria. The REDP was included as the "best practice" programme in a number of UNDP publications. The REDP has also collaborated with the University of Flensberg, Germany in conducting the International Classrooms to its around 30 international students pursuing Masters' degree SESAM in two consecutive years 2000 and 2001. More than 30 students from national and international colleges and universities have written theses on different aspects of the REDP for the Masters and Ph.D. degrees. The REDP was awarded with the Pearl of Knowledge Award in the Asia Pacific Knowledge Fair organized by the UNDP RBAP at Bangkok from 27 to 29 April 2005.

2.5 Policy Formulation

The DDC is required to accord the rural energy as an integral component of the district development plans and programmes for the implementation of the REDP. The policy decision is made from the DDC Council for the creation of local rural energy institutions, implementation of decentralized rural energy planning process and operational modality, and approval of the DEF guidelines ensuring annual resources allocation for rural energy sector and mandatory investment of minimum of 5% of the total cost of each micro hydro system.

In addition, the REDP has supported the ADDCN and NAVIN for the institutional strengthening on the rural energy. The ADDCN has created the Natural Resources, Energy and Environment (NaREE) Unit and the NAVIN is at the final stage for institutionalization. Both organizations have been playing active roles on advocacy, lobbying, networking and provision of policy guidance to their respective members, namely DDCs and VDCs.

The mid-term evaluation of the Ninth Plan has acknowledged highly of the impressive outputs and results produced from the implementation of the REDP at all levels. Based upon the lesson learned and impact made at local levels, the HMGN has accorded high priority for the promotion of rural energy technologies for the

holistic development and poverty reduction in the Tenth Five Year Plan (2002-2007). The plan has set a target of promoting micro hydro systems and other rural energy technologies in 1,000 VDCs thereby increasing the contribution of rural energy technologies to the electricity access in the remote locations.

The National Planning Commission (NPC), with the support of UNDP TTF, has taken a lead role in the formulation of the Rural Energy Policy which is at the final stage of approval. The paper was prepared following a series of extensive discussion and consultations with stakeholders at all levels. More than 450 experts, implementers, academicians and local people have actively participated in four regional and one national consultative meetings organized by the NPC and provided comments and suggestions which were duly incorporated in the revision made after each meeting. The policy paper was further reviewed by a team of four experts on technology, governance, management and legal aspects for scrutiny and refinement. The policy paper was presented in a focused group discussion participated by senior government officials and planners for further comments and suggestions. Finally, an experienced legal expert was hired to finalize the policy paper for the conformity of formats, contents, and terminology. Maim features of the Rural Energy Policy are:

- Pro-poor Focus
- Decentralized Planning, Institutions and Operations,
- Holistic Development and Poverty Reduction
- Discriminatory Subsidy for Targeting Poor and Vulnerable Communities
- Mechanism for the Mobilization of Internal Resources
- Capacity Building at All Levels
- Multiple Uses of Energy Resources and Electricity
- R&D for the Availability of Multiple Technological Options
- Mainstreaming Gender and Vulnerable Communities
- Continuing Assessment for Improvement based on Emerging Needs

3. PRODUCTIVE USES OF COMMUNITY MANAGED MICRO HYDRO SYSTEMS DEVELOPMENT

3.1 Guiding Principles

The REDP emphasis for the sustainable rural development through the promotion of rural energy technologies, primarily micro hydro systems as the entry point for social capital building, economic growth and environmental management. It is mandatory that each and every household irrespective of caste, creed, sex and economic status has access to the electricity services in the community. The biggest challenge, thus, is to help all rural households to generate additional monthly income of at least Rs. 25 for making them able to pay the electricity tariff for the minimum subscription of 25 watt connection. Two key indicators of the sustainable management of a micro hydro system are:

- Operation of MH systems without technical, financial, and social problems, and
- Collection of electricity tariff on time from consumers both households and commercial.

3.2 Supports Package

The REDP has designed and successfully implemented the pragmatic supports package suitable at the community levels for formation of functional institutions, development of trained manpower and generation of additional income.

3.2.1 Formation of Functional Institutions

- Formation of Micro Hydro Functional Groups: It is the federated organization of all Community Organizations formed at the community level
- Establishment of Community Energy Fund: Sources include electricity tariff, charity, contributions, levy, loan, equity, etc. Similarly, the fund is used for meeting operating expenses (salary, stationeries, repair and maintenance, replacement of parts), loan repayment, dividend, community initiatives, etc.
- Rules and Regulations: Tariff fixation guidelines, CEF operational manual including book keeping, penalty and fine for late tariff collection and theft of electricity, provision for collecting tariff in cash, kind or labor, etc.
- Monitoring and Auditing: Monthly meeting of MHFG, public auditing upon the commissioning of the system, general audit by a registered auditor

3.2.2 Development of Trained Manpower

- MH Operation: Training of one or two villagers nominated by MHFG depending upon the plant capacity as MH Operators
- MH Management: Training of one villager nominated by the MHFG as MH Manager
- Repair and Maintenance: Training of one or more Repair and Maintenance technicians from potential entrepreneurs. They are also provided with basic business skills for marketing electrical goods such as bulbs, cables, fuses, etc at community levels.
- Operation and Management: Workshop seminar, orientation and exposure visits to community people for awareness creation, disputes handling, book-keeping accounting, leaderships, group dynamics, etc.

3.2.3 Generation of Additional Income

- Multiple uses of electricity and natural resources (land, water, forests and traditional skills).

  Uses of Electricity in Agro-processing, bakery, cable network, computer training institute, photo studio, furniture shops, consumer shops, poultry raising, handicrafts (such as thanka, incense stick, bamboo mat), Nepali paper making, ropeway (planned), feed mill (planned), stone crusher (planned), milk processing (planned), herb processing (planned), water purification (planned)

  Uses of Land possible from the assured water for irrigation from headrace and tailrace canals of MH system resulting into increase in production from the increased cropping intensity as well as increased productivity, increase

income from cultivation of high value crops such as vegetables, onion and garlic

Uses of Water for irrigation (gravity and lift), electricity and drinking water (planned)

Uses of Forests for fuelwood, timber, fruits, NTFPs (herbs and medicinal plants), cardamom, tea, coffee, bamboo,

Uses of traditional Skills such as handicrafts, carpentry, tailoring, shoe making, blacksmith, wood carving, etc.

- Campaign: "One Household One Enterprise"
- Training to impart skill (includes product development and business operation) on various appropriate and feasible income generating activities and micro enterprises development such as poultry raising, agro-processing, cultivating high value crops, processing of non-timber forests products, etc.
- Information and linkages to help reach urban and export markets, get competitive prices for products, access resources of line agencies (through District Energy Committee) and financial institutes
- Fund Mobilization:

Creation of Revolving Fund : REDP provides Rs. 10,000/kW not exceeding the total amount of Rs.250,000) for providing credit to members for carrying out income generating activities and micro enterprises.

Operating weekly saving and credit for providing small and start-up credit to members for undertaking productive activities.

Linking with Financial Institutes by signing a Memorandum of Agreement (MOU) between Agricultural Development Bank of Nepal and REDP for ensuring easy flow of bank credit to community people of programme areas.

3.3 Physical Achievements

The establishment and operation of productive uses of micro hydro systems are in the increasing trend with the increase in the number of micro hydro systems as well as the increase of income generating activities and micro enterprises as more and more villagers have started undertaking them as the results of the demonstration effects, participation in training and increased access to information and financial resources. The physical achievements are summarized below

Unit in number

Particulars	Actual (as of 2004)	Estimates (2005& 2006)	Remarks
A. Micro Enterprises			
1. Agro Processing Mills	78	100	Grinder, Huller and Expeller
2. Rural Furniture Shops	10	50	Furniture, Window and Door Frames
3. Poultry Farming	90	100	Feasible in rural areas only after

			availability of electricity
4. Rural Bakery	7	15	Slow. It needs change in food habits
5. Computer Institute	2	5	
6. Cable TV networks	5	20	
7. Rural Photo Studios	27	25	
8. Mechanical Workshops	3	10	
9. Video Cinema Halls	17	15	
10. Radio & TV Repair Shops	5	25	
11. Rural I&C Centers	-	5	
12. Battery Charging Stations	22	25	
B. Income Generating Activities			
1. High Value Crops	Numerous at individual households. Vegetables, garlic, onion, mushroom, etc.		
2. Improved Livestock	Numerous at individual households. Goat, Pig, Cattle, etc.		
3. NTFP	Started at pilot scales. Tea, Coffee, Cardamom, Fruit Trees, Herbs, Mulberry, etc.		
4. Handicrafts	Numerous at individual households. Bamboo Products (doko, nanglo), Woolen Products (radhi, pakhi), Thanka Painting, Incense Sticks Making, Nepali Paper, etc.		
5. Commercial Ventures	Electricity has helped in upgrading and/or running longer hours after dark. Grocery Stores, Tea Shops, Tailoring Shops, Carpentry, Black Smithy, Radio, TV and Watch Repair Shops, etc.		
6. Miscellaneous	Households (cleaning, washing utensils, sewing, reading) Community (meeting, literacy class, ceremony and festivals)		

4. LESSONS LEARNED

- Micro hydro systems are clean and environment friendly technology for generating power for households and commercial uses in scattered and small settlements.
- Community micro hydro system development based on community mobilization is feasible for inclusive rural development and poverty reduction encompassing all households irrespective of class, cast, creed sex and economic status. In the context of Nepal, it is the best proven modality to access electricity to the poor which is neglected or marginalized by the grid extension and also by the private owned micro hydro systems development.
- Holistic development approach is essential for the sustainable operation and management of the micro hydro systems. The energy alone is not suatainable.
- In case of Nepal, the micro hydro systems are cheaper solution to electrify remote settlements as extending the national grid to small villages is not financially viable due to the high cost of electricity transmission and distribution, low load factor and poor economic conditions.
- Rural people are capable of planning, implementation and management of micro hydro systems with the proper guidance and supervision.
- People-led micro hydro systems development can work and sustain in the difficult security situations.

- Women are more active in micro hydro systems development than men as electricity and additional income make their lives easier and fulfilling. Positive discrimination is necessary to empower women and vulnerable communities that include indigenous people, marginalized community and ethnic groups.
- The availability of power spurs the promotion of income generating activities and micro enterprises as rural people are always in search of opportunities and options for employment ands income generation to fulfill their basic needs and other needs.

5. CONCLUSIONS

The REDP as a "best practice" programme has demonstrated and institutionalized the modality for successful planning, implementation and management of rural energy systems, particularly micro hydro for social, economic and environmental enhancement for sustainable development and poverty reduction. The formulation of the national rural energy policy by the National Planning Commission/ HMGN with the supports of the UNDP Energy Thematic Trust Fund validates these lessons. Similarly, the provision of funding by the World Bank (US$5.5 million) to up-scale and expand the REDP activities in over 150 communities attests its achievements and replicability. Similarly, the Pearl of Knowledge Award awarded to the REDP in the UNDP Asia Pacific Knowledge Fair held from 27 to 29 April 2005 at Bangkok further endorses its success.